# Michael F. Barad, Ph.D., P.E.

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## Education

July 2006 *Ph.D. in Civil and Environmental Engineering*
**University of California, Davis**, Department of Civil and Environmental Engineering
Dissertation: An Adaptive Cartesian Grid Projection Method for Environmental Flows
Thesis Committee: S. Geoffrey Schladow, Phillip Colella, E. Gerry Puckett

1997 *Master of Science in Civil and Environmental Engineering*
**University of California, Berkeley**, Department of Civil and Environmental Engineering

1993 *Bachelor of Science in Civil and Environmental Engineering*
**University of Colorado, Boulder**, Department of Civil and Environmental Engineering

## Fellowships and License

*Mathematical Sciences Postdoctoral Research Fellowship*, National Science Foundation, 2006-Present

*Computational Science Graduate Fellowship*, Department of Energy, 2002-2006

*Ecotoxicology Fellowship*, John Muir Institute for the Environment, 2001-2002

*Professional Engineer*, State of California, License #58798, 1999-Present

## Research Experience

2006-Present: *Postdoctoral Fellow*, **Civil and Environmental Engineering**, Stanford University

Simulated multiscale, highly nonlinear, stratified flows. Specifically, oceanic internal gravity waves, and limnologic circulation. Continued development of my embedded boundary, adaptive, incompressible Navier-Stokes solver.

2002-Present: *Guest Researcher*, **Applied Numerical Algorithms Group**, DOE-LBNL

Developed a fourth-order accurate local refinement method for Poisson's equation. Extended the coupled embedded boundary, adaptive mesh refinement capability of the Chombo numerical library for the study of the incompressible Navier-Stokes equations.

2002-2006: *DOE CSGF Fellow*, **Civil and Environmental Engineering**, U.C. Davis

Developed an adaptive, three-dimensional, variable density, incompressible Navier-Stokes solver. The solver is designed to execute on both workstations and distributed-memory parallel supercomputers, uses high accuracy embedded boundaries, and adaptive mesh refinement.

2000-2002: *Research Assistant*, **Civil and Environmental Engineering**, U.C. Davis

Coordinated over 10 researchers and successfully collected six months of estuarine hydrodynamic data at numerous sampling stations in San Pablo Bay, CA. Various instruments were deployed including: acoustic Doppler profilers, current meters, conductivity-temperature-depth-optical sensors (fixed and profiling). Processed the raw data into a comprehensive digital database currently employed by interdisciplinary researchers.

1992-1993: *Scientific Programmer*, **CADSWES**, Boulder, CO

Developed a numerical reservoir routing model for use by government resource managers.

## Consulting Experience

1997-2000: *Hydrologist and Associate*, **Philip Williams and Associates**, San Francisco, CA

Managed dozens of aquatic restoration/enhancement projects. For these studies I constructed 1D and 2D numerical models to investigate physical processes relating to: rainfall-runoff, sediment transport, riverine hydraulics, lake and estuarine circulation. These projects were mostly interdisciplinary, multi-million dollar wetland restoration projects that required coordination among biologists, geologists, hydrologists, landscape architects, oceanographers, political interests, county and state governments. Became licensed as a California professional engineer in civil engineering.

1996: *Numerical Modeling Consultant*, **Montgomery Watson**, Sacramento, CA

Enhanced a three dimensional groundwater model. Performed validation runs, and assisted with quality control.

1995: *Numerical Modeling Consultant*, **Philip Williams and Associates**, San Francisco, CA

Developed a reservoir and river routing numerical model for use by consultants. Performed validated runs, and assisted with quality control.

## Refereed Publications

Schwartz, P.O, M.F. Barad, P. Colella, and T.J. Ligocki, 2005 "A Cartesian grid embedded boundary method for the heat equation and Poisson's equation in three dimensions", *J. Comp. Phys.*, **211**(2), 531-550

Barad, M.F. and P. Colella, 2005 "A fourth-order accurate local refinement method for Poisson's equation", *J. Comp. Phys.*, **209**(1), 1-18

Ganju, N.K., D.H. Schoellhamer, J.C. Warner, M.F. Barad, and S.G. Schladow, 2004 "Tidal oscillation of sediment between a river and a bay: a conceptual model" *Estuarine, Coastal, and Shelf Science*, **60**(1), 81-90

Juza, B., and M.F. Barad, 2000 "Dynamic and steady state modeling approaches to riverine hydraulic studies using 1-D, looped 1-D, and 2-Dimensional topological discretizations." *Conference Proceedings of Hydroinformatics*, Iowa City, Iowa.

## Manuscripts in Preparation

Barad, M., P. Colella, D. Graves, T. Ligocki, P. Schwartz, B. VanStraalen, and D. Trebotich, "A Cartesian grid embedded boundary method for the incompressible Navier-Stokes equations" In preparation for the Journal of Computational Physics.

Barad, M., P. Colella, D. Graves, B. VanStraalen, "An adaptive Cartesian grid embedded boundary method for the incompressible Navier-Stokes equations" In preparation for the Journal of Computational Physics.

Barad, M.F., O.B. Fringer, and P. Colella, S.G. Schladow, "Multiscale simulations of internal gravity waves: generation, propagation and dissipation", In preparation for Ocean Modelling.

Barad, M.F., P. Colella, S.G. Schladow, "An adaptive Cartesian grid projection method method for environmental flows", In preparation.

## Non-Refereed Papers and Reports

Barad, M.F., O.B. Fringer, and P Colella, 2006, "Multiscale simulations of internal gravity waves", *Conference Proceedings of the Sixth International Symposium on Stratified Flows*, Perth, Australia, Submitted

Haltiner, J. H., M.F. Barad, and A. Rucker, 2000, "Carmel River Odello East: enhancement and management plan: conceptual design report", Philip Williams and Associates, Ltd. Technical Report #1337. For Monterey Peninsula Regional Park District, Corte Madera, CA.

Haltiner, J. H., M.F. Barad, and A. Rucker, 1999, "Carmel River Lagoon: enhancement and management plan: conceptual design report" Philip Williams and Associates, Ltd. Technical Report #1250. For Monterey Peninsula Regional Park District, Corte Madera, CA.

Mead, A., M.F. Barad, B. Juza, and P.B. Williams, 1999, "Flood hazard, sediment management, and water feature analyses, Hahamonga Watershed Park" Philip Williams and Associates, Ltd. Technical Report #1310. For Takata Associates, Corte Madera, CA.

Battalio, B., J.H. Haltiner, M. Orr, and M.F. Barad, 1999, "Hydrologic analysis and design of the Cooley Landing Tidal Marsh restoration" Philip Williams and Associates, Ltd. Technical Report #1225. For Rhone-Poulene Inc, Corte Madera, CA.

Haltiner, J. H., and M.F. Barad, 1998, "Santa Margarita Watershed study: hydrology and watershed processes" Philip Williams and Associates, Ltd. Technical Report #1132. For Riverside County Flood Control and Water Conservation District, San Francisco, CA.

Barad, M.F., R. Kamman, B. Battalio, and J.T. Harvey, 1998, "Corte Madera Ecological Reserve Harbor Seal habitat protection study" Philip Williams and Associates, Ltd. Technical Report #1170. For Golden Gate Bridge, Highway and Transportation District, San Francisco, CA.

Mead, A., P.B. Williams, and M.F. Barad, 1998, "Conceptual multi-use seasonal wetlands enhancement plan for the North Parcel and Leonard Ranch, Sonoma Baylands" Philip Williams and Associates, Ltd. Technical Report #1079. For the Sonoma Land Trust, San Francisco, CA.

Barad, M.F., and J.H. Haltiner, 1997, "Alhambra Creek flood frequency analysis" Philip Williams and Associates, Ltd. Technical Report #1134. For the City of Martinez, San Francisco, CA.

Barad, M.F., and J.H. Haltiner, 1997 "Estimation of water surface elevations: Wildcat Creek in Alvarado Park" Philip Williams and Associates, Ltd. Technical Report #1208. For East Bay Regional Park District, San Francisco, CA.

### Select Presentations

Barad, M.F., O.B. Fringer, and P. Colella, 2006. "Multiscale simulations of internal gravity waves", Sixth International Symposium on Stratified Flows, Perth, Australia. 2006.

Barad, M.F., 2006. "An embedded boundary adaptive mesh refinement method for highly nonlinear internal waves", DOE CSGF Annual Fellows' Conference, Washington, DC. 2006.

Barad, M.F., 2006. "An adaptive multiscale numerical method for highly nonlinear internal waves", AGU/ASLO Ocean Sciences 2006, Honolulu, HI.

Barad, M.F., 2005. "An embedded boundary adaptive mesh refinement method for environmental Flows", 9th International Conference on Estuarine and Coastal Modeling, Charleston, SC.

Barad, M.F., 2005, "An embedded boundary adaptive mesh refinement method for environmental Flows". Stanford Environmental Fluid Mechanics and Hydrology Seminar. Stanford, CA. Invited.

### Computational Skills

Programming languages: C, C++, FORTRAN 77/90/95, MPI
Numerical packages: Chombo, Mathematica, Matlab
Legacy water software: HEC-1, HEC-RAS, MIKE 11, MIKE 21, MIKE SHE, MODFLOW
Other relevant software: ArcView GIS, LaTeX, Linux, Mac OSX, MS Office, MS Windows
Hardware: laptops, workstations, Linux clusters, massively parallel supercomputers

### Professional Memberships

American Geophysical Union
American Physical Society
American Society of Civil Engineers
American Society of Limnology and Oceanography
Society for Industrial and Applied Mathematics

## Research Examples

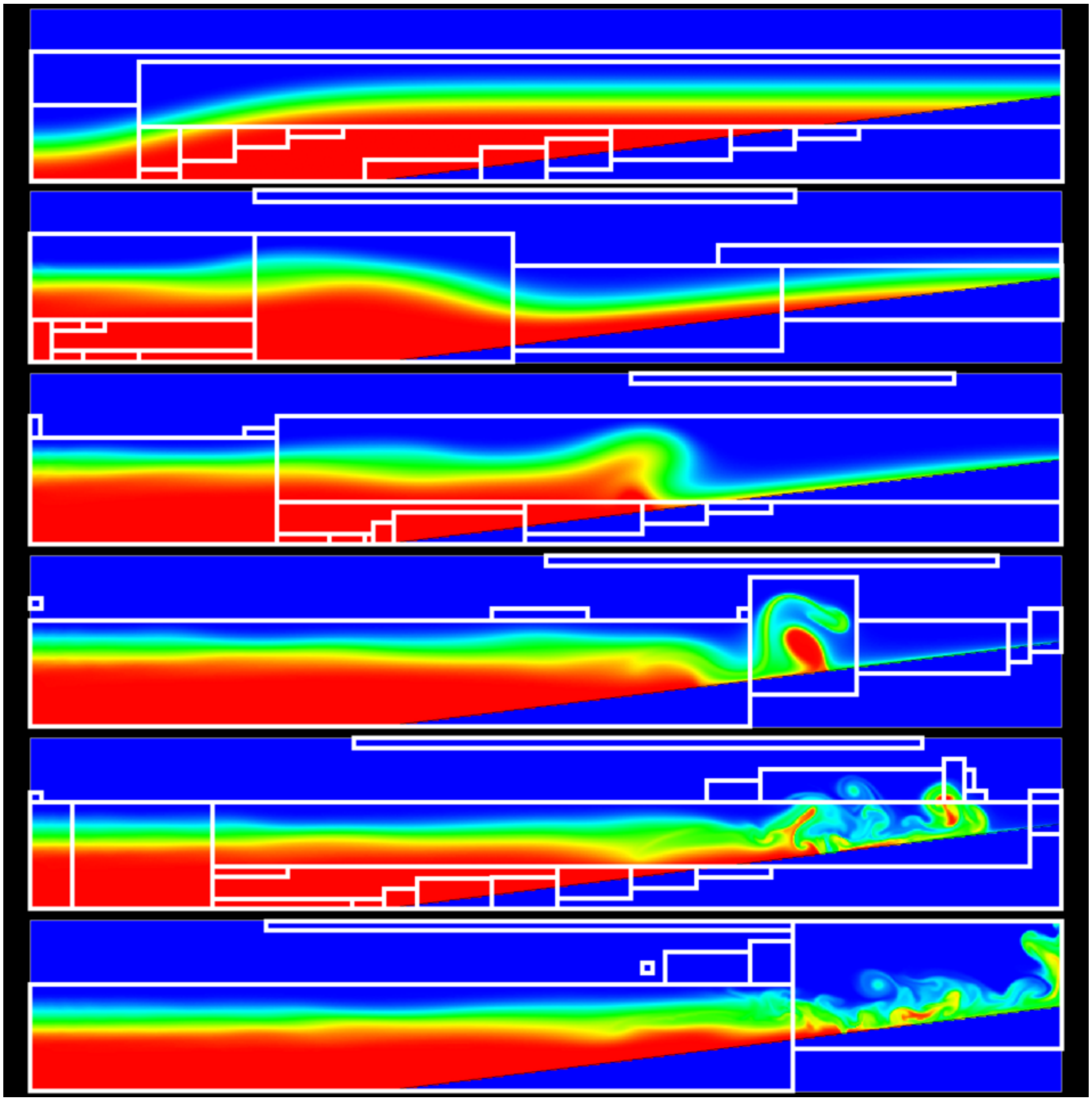

Figure 1: Breaking internal wave on a slope using my second-order accurate, nonBoussinesq, nonhydrostatic, conservative, adaptive mesh refinement, embedded boundary numerical model. Red is a heavy fluid (salt water), blue is light (fresh water). Note that the white boxes indicate adaptive mesh refinement patches. A movie is available here: http://www.stanford.edu/%7Ebarad/movies/breakSmooth10cm.mpg

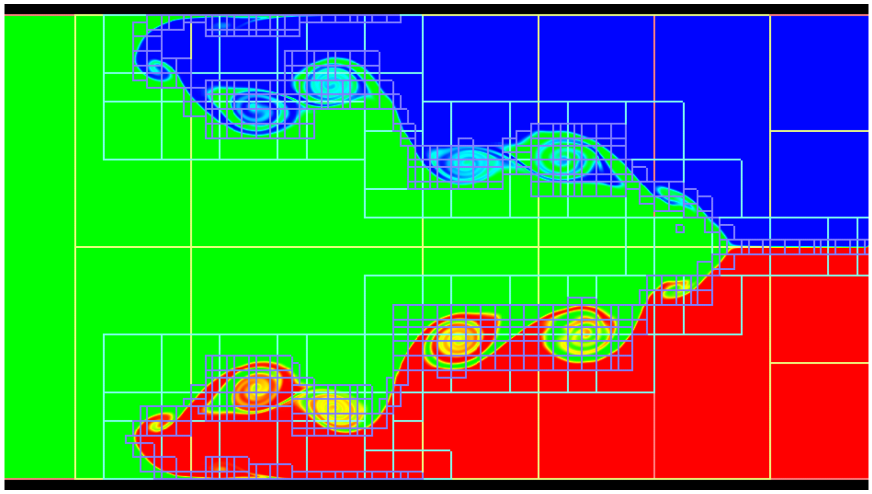

Figure 2: Intrusive gravity current simulation using my adaptive mesh refinement model. Red is a heavy fluid (salt water), blue is less dense (fresh water), green is the average density. Mesh refinement efficiently tracks vorticity and density gradients, and permits accurate multiscale computations. Note that the boxes indicate adaptive mesh refinement patches, with each refinement level marked by a color. A movie is available here: http://www.stanford.edu/%7Ebarad/movies/intrusion.gif

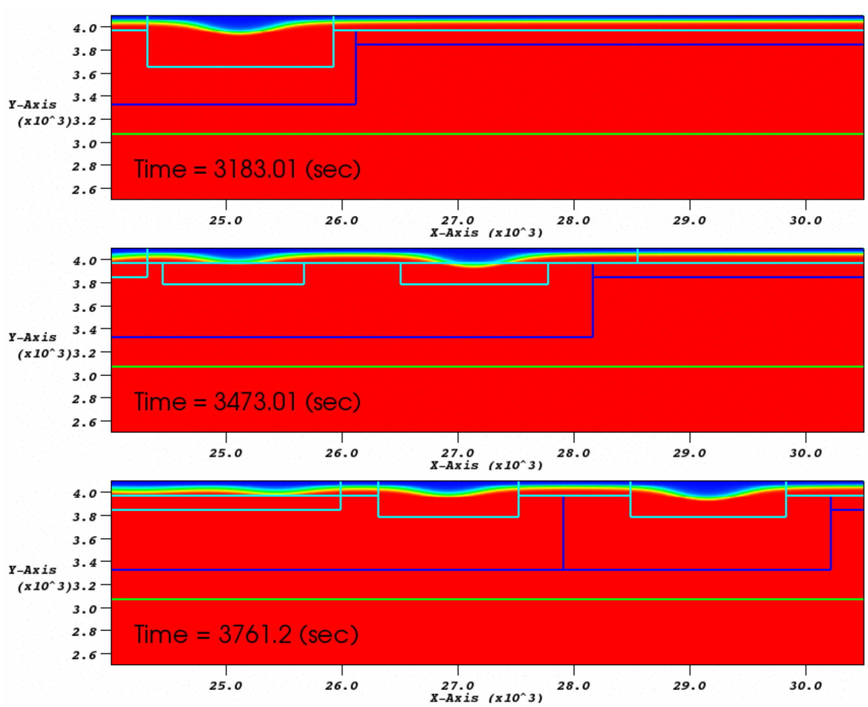


Figure 3: Multiscale simulation of oceanic internal gravity waves. Red indicates areas with heavier waters, blue indicates areas with lighter waters. Light blue boxes are areas of 8 m mesh spacing, dark blue boxes are areas of 32 m mesh spacing, green boxes are areas of 128 m mesh spacing, and the remaining mesh has a 512 m mesh spacing. Notice that the fine boxes track the waves. A movie is available here: http://www.stanford.edu/%7Ebarad/movies/oceanWaves.gif